MAGNETIC SURVEYING

Magnetic surveys are primarily used to detect ferrous metals, iron and steel. The earth's magnetic field (geomagnetic field) has the shape of a bar magnet and exhibits an intensity which ranges from 70,000 gammas (nanoteslas (nT)) at the Polar Regions to 25,000 gammas at the equator. The field is shifted some 11 degrees from the earth's rotation which causes a deviation from true north, resulting in a point referred to as magnetic north. Where local variations in magnetic materials occur, anomalies within the total magnetic field of 1-5000 gammas may result.

Detection of anomalies is a function of the differences in contrasts due to the material's magnetic susceptibility, remnant magnetization, size, shape and orientation of the magnetic feature and distance between the feature and point of measurement. Magnetic susceptibility is the ease with which a material can be magnetized by earth's field or an induced field (such as a magnet). Remnant magnetization is the natural or permanent magnetization displayed by a material in the absence of a magnetic field.

The significance of magnetization to the forensic investigator is that most weapons have a high magnetic susceptibility, and thus they are capable of being detected by magnetic surveys. Soils display remnant magnetization in the first few feet below the ground surface. Should soils be altered by excavation, such as for a grave, their remnant magnetization will also be altered, resulting in a magnetically anomalous condition, which often can be detected by magnetic surveying.

Magnetic measurements are made by utilizing an instrument called a magnetometer.

Limitations

The type of targets commonly sought by the forensic investigator, weapons and excavations, result in relatively small magnetic contrasts in the subsurface. Magnetic "noise" due to cultural features, geologic conditions and solar activity can mask these small contrasts:

- Cultural features include electrical power lines, pipes and pipelines, metal structures both underground and above ground, fences, metal signs, automobiles and metallic surface trash. High noise levels can make interpretation difficult and, in some instances, can make data collection and interpretation impossible.

- Geologic conditions: magnetic surveys are affected by rocks and soils having high magnetic susceptibilities or remnant magnetism. Igneous and metamorphic rocks contain relatively high volumes of the mineral magnetite. Soils derived from them may have concentrated amounts. Highly organic soils produce maghemite, the magnetic form of the mineral hematite.

- Solar Activity: solar winds and solar magnetic storms (resulting in sunspots) can greatly affect results obtained from magnetic surveying. Daily solar activity, referred to as diurnal change, can produce spurious anomalies on the order of 100 gammas in the course of a day's surveying. A 100-gamma anomaly can also be expected from a pistol at a distance of one meter from a magnetometer. The National Weather Service, the Solar Forecast Center (Boulder, CO) and the National Geophysical Data Center (Golden, CO) can provide predictions of solar magnetic activity. The use of a base station magnetometer and/or magnetic gradient surveys diminish or eliminate the effects of normal diurnal changes.